

ENVIRONMENTAL SPEECHES
OF THE
HONORABLE ROBERT T. STAFFORD
UNITED STATES SENATOR
FROM THE
STATE OF VERMONT

DELIVERED IN THE SENATE OF THE
UNITED STATES
SEPTEMBER-OCTOBER 1988



OCTOBER 1988

OCTOBER 12, 1988.—Ordered to be printed

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1988

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FOREWORD

During the closing days of the 100th Congress, Senator Robert T. Stafford of Vermont delivered a series of 17 floor statements attempting to summarize the threat to humanity posed by the massive contamination of the atmosphere by air pollutants and other chemicals. Although Senator Stafford was retiring at the end of the 100th Congress, it was his hope that a series of such statements would alert his colleagues, the press, and the public to a threat to humanity's survival as great as any ever confronted by the human race.

The text of the speeches follows.

SEPTEMBER 12, 1988

ATMOSPHERIC CONTAMINATION—I

Mr. STAFFORD. Mr. President, as I near the end of 28 years of service in the U.S. Congress, including 17 in the Senate, I look back on those years with much satisfaction and gratification.

Much of that good feeling results from my membership, beginning when I came to the Senate, on the Committee on Environment and Public Works, which has occupied so much of my time and energy throughout the years.

I take pride in the many environmental accomplishments that have been recorded during that period through the efforts of so many other Senators and through their willingness to let me share in those efforts. While I will retire with some regrets, those regrets are few in number.

One of those regrets, however, is that I have been unable to convince the Congress to take the steps I feel are necessary to have our Nation lead the world in the kind of action needed to recapture the purity of our air.

Because of that regret, I ask the Senate to permit me to take a few minutes today and in the remaining days of this session of the Congress to discuss some matters of vital importance regarding the quality of our planet's air.

I refer to this subject as atmospheric contamination. Others call it by a variety of different names—acid rain, smog, global warming, and ozone depletion, to cite just a few.

Typically, these are viewed as separate and individual manifestations of air pollution, but, they are not separate.

They are connected to each other just as are the fever and chills and upset stomach of a sick child. Just as a sick child may have a variety of symptoms, so the environmental illness that now infects our planet's air is displaying itself in different, and sometimes confusing, ways.

It is one of my remaining hopes that, before this Senator leaves this Chamber for the last time, the groundwork will have been laid here that will help the United States, and the world, to respond to this threat. To counter the threat to humanity posed by atmospheric contamination will require the human race to change some of its ways. But, those changes need not require significant sacrifices.

We have accepted the changes in public health programs that have brought us the vaccines that have eradicated smallpox and conquered polio. We have adjusted to the changes required to use electricity, refrigeration, jet airplanes, and even computers without much sacrifice. Indeed, the argument can be made that we live richer and longer lives because of those changes.

If we can only recognize this circumstance for what it is—an opportunity to redirect ourselves toward a brighter future—then setting ourselves to the task ahead will be not a burden, but a joy.

We humans have degraded the environment of our world, and now we must set ourselves on the path of reversing that course. It will not be an easy task to accomplish, but it is a necessary one.

The threat is the result of the massive infusion of billions upon billions of pounds of pollutants into the air of our planet.

If humanity ever understood the role the atmosphere plays in the life of this planet, we seem to have forgotten it in recent years.

Air does not occur naturally. It was not here when the Earth was formed. The atmosphere on this planet is the product of living things. Animals, like ourselves, produce the carbon dioxide. Plants, like trees, produce the oxygen.

Once present on the planet, the atmosphere traps heat, allowing life to continue and to evolve. The atmosphere also screens out the radiation of the Sun, which otherwise would literally incinerate every living thing it touched. The air is also a nutrient, like the food on our table. We take our food one bite at a time. We take our air one breath at a time. They sustain our lives.

But, poison either and our lives are threatened.

Clearly, we have allowed pollution to poison our air in many ways. The result has been that trees, fish, and human beings have been caused to fall ill and die.

Pollution has also altered the ability of the atmosphere to allow just the right amounts of life-sustaining heat from the Sun to enter and to leave our environment. As a consequence, the Earth is becoming hotter, which threatens to cause shifts in climate that will alter life on this globe.

At the same time, manmade chemicals have thinned the ozone shield that protects us from the ultraviolet radiation from the Sun.

And, of course, we are more familiar with the various forms of air pollution closer to the ground—the pollution that irritates our eyes and our lungs and that threatens our health more directly.

Tomorrow, I will present to this body a more detailed outline of the unfinished air pollution agenda that must be addressed in the immediate future.

I propose not only to set down the challenges we face, but also to offer some solutions. It is not too late to correct our errors of the past.

Mr. President, I yield the floor.

SEPTEMBER 13, 1988

ATMOSPHERIC CONTAMINATION—II

Mr. STAFFORD. Mr. President, the 20th century has produced staggering increases in world population and in technological development and economic activity around this planet.

That combination of circumstances has changed—mostly for the better—both the quality and the style of life for billions of inhabitants of Earth.

That combination of circumstances has also changed—mostly for the worse—the quantity and the nature of the pollutants that we have pumped into the atmosphere that sustains all life on this planet.

For the most part, we have used fossil fuels as the major energy source that has driven our engine of change. And, fossil fuel combustion has produced some of the major pollutants that threaten life on Earth as we know it.

We have also released scores of industrial chemicals into our air, with similar results—new threats to all living things on Earth.

All inhabitants of this planet are at risk, and it is my hope that the United States will lead the nations of the world on a course of action that will reverse this pattern of pollution and that will enable us to recapture the purity of our air.

It is my hope that the Senate will permit me to take a few minutes during each of the remaining mornings of this session of Congress to discuss atmospheric contamination and some proposals for reversing that trend.

In the days to come, I would propose to discuss the following subjects that are key parts of the unfinished agenda regarding atmospheric contamination:

An overview of the various pollutants and other chemicals that are overwhelming the global environment.

Carbon dioxide and the role it plays in global warming.

Chlorofluorocarbons (freons) and the role they play in the depletion of the ozone layer.

Sulphur dioxide and the role it plays in acid rain as well as its impact on human health.

Oxides of nitrogen and ground level ozone and the threat they pose to human health and the environment.

Other pollutants, such as carbon monoxide and methane, and the catalytic role they play with other air pollutants.

I also intend to examine the following:

The evidence that the climate of the globe has started to change. This evidence is so compelling that prudence dictates that we begin to consider the possibility that it may be a major reason for worldwide drought, crop failures, a record number of forest fires throughout North America and even flooding in Bangladesh.

The accumulating mass of evidence that ground level ozone—we call it smog—is responsible for crop and forest damage and that breathing it at concentrations that occur commonly in the United States is the same as smoking a cigarette.

The now conclusive proof that industrial chemicals have destroyed huge quantities of stratospheric ozone, just as scientists warned us nearly 15 years ago.

The equally well-established proof that clouds, fog, rain, and snow are now so acidic in many places that a morning mist or a summer shower can have the characteristics of lemon juice, vinegar, or even approach acidity of battery acid.

And, finally, the linkages of each of these to one another. How these chemicals form a soup that attacks our health and our envi-

ronment. How a hotter climate increases ground level ozone, which then traps more heat, thus speeding up ozone depletion in the stratosphere.

I shall also discuss some possible solutions to the dangers that result from atmospheric contamination.

It is also my intention to examine two fundamental alternatives available to the human race in dealing with atmospheric contamination.

We stand, literally, at a fork in the road.

Down one path is a bright new future for ourselves and for our children and for their children.

Down the other path is a future that this Senator would rather not contemplate—a future that we can avoid once the alternatives are known and understood.

Mr. President, I will be back tomorrow. I yield the floor.

SEPTEMBER 14, 1988

ATMOSPHERIC CONTAMINATION—III

Mr. STAFFORD. Mr. President, I have in my hand a common styrofoam coffee cup, the kind, until recently, used in Senate cafeterias and dining rooms in this building.

The blowing agent that helps to hold this cup rigid and that provides insulation is one of a family of chemicals known as chlorofluorocarbons, CFCs for short, or freons as the public knows them. These are the chemicals that are used as cleaning agents in manufacturing processes and as refrigerants.

The chemical used in this cup has a lifetime of 150 years. And, when it is released into the atmosphere—and it will be released into the atmosphere sooner or later—this CFC will play its part in the destruction of the Earth's stratospheric ozone layer and in the creation of the so-called greenhouse effect.

Production of CFCs was commercially insignificant until 1931. But, by 1984, the production of only two of the chemicals in this family—CFCs 11 and 12—was about 1.4 billion pounds.

Each pound of CFC contains billions of molecules of CFCs and each of those molecules has the ability to destroy 100,000 molecules of stratospheric ozone.

Each and every molecule of CFCs ever produced by a man is still in existence today and will still be around for another century or so and will continue destroying ozone molecules in the stratosphere day after day.

Those ozone molecules make up the ozone layer in the stratosphere that protects all living things on Earth from the deadly radiation of outer space. That layer is being weakened everywhere by CFCs. In addition, over the Antarctic, a hole in the layer as big as North America occurs each winter.

The message is clear—the release of CFCs into the air is a threat to life on Earth. And, CFCs are not the exception. They are the

rule. We are flooding the atmosphere with a variety of polluting chemicals that threaten our health and our lives.

In the United States alone, each year we dump an average of 37,000 pounds of air pollution into the atmosphere for each man, woman, and child in this country.

Our use of fossil fuels to power the development of the world in the 20th century has resulted in sixfold increases in annual sulphur dioxide emissions since 1900. Nitrogen oxide emissions have increased tenfold in the same period. These gases, along with hydrocarbons, are the major sources of both urban air pollution and acid rain.

Fossil fuel combustion also forms carbon dioxide, one of the gases believed to cause global warming and climate change. Annual global emissions of carbon dioxide have increased tenfold in this century.

Depending on its capacity, each tank of gasoline produces about 400 pounds of carbon dioxide. The average electric powerplant sends 2 pounds of coal up its smokestack for every pound it converts into electricity.

Most of the pollutants we pump into our atmosphere do not exist in nature, and of those that do occur naturally, they do so in vastly smaller quantities.

So, it is easy to overlook the enormous aggregate total and, more importantly, the extreme potency of many of the pollutants. For example, concentrations of ground level ozone are regulated by the Environmental Protection Agency under provisions of the Clean Air Act. The EPA has established 12 parts per billion of ozone as a level that is safe.

But, ozone is a potent chemical agent. At 12 parts per billion, ozone begins to change cell walls within seconds of entering the human lung. We have this knowledge at a time when the soup of pollutants we breathe is thicker and more unhealthy than ever before.

Up to now, as our standard of living has advanced through rising levels of industrial production, pollution has increased as well. We must uncouple those two conditions before it is too late.

We have to produce less pollution by using less fossil fuel and by eliminating the releases of other chemicals, like CFCs, that cause us so much trouble. It is pollution that costs us so much money, not pollution control.

I ask unanimous consent that tables and other data summarizing the amounts of pollution released in the United States and in the rest of the world be printed in in the Record.

The ACTING PRESIDENT pro tempore. Without objection, it is so ordered.

ANNUAL EMISSIONS OF ENVIRONMENTALLY IMPORTANT TRACE GASES, 1925-85

Year	Chlorofluorocarbons (thousand metric tons)		Carbon dioxide (million metric tons of carbon)	
	CCl ₃ F (CFC-11)	CCl ₂ F ₂ (CFC-12)	Biotic sources	Fossil fuel combustion and industrial processes
1925.....	0	0	886	X
1926.....	0	0	942	X
1927.....	0	0	997	X
1928.....	0	0	1,045	X
1929.....	0	0	1,059	X
1930.....	0	0	1,073	X
1931.....	0	.1	1,087	X
1932.....	0	.1	1,101	X
1933.....	0	.1	1,101	X
1934.....	0	.2	1,135	X
1935.....	0	.3	1,149	X
1936.....	0	.5	1,163	X
1937.....	0	.8	1,184	X
1938.....	.1	1.2	1,191	X
1939.....	.1	1.7	1,205	X
1940.....	.1	2.3	1,218	X
1941.....	.1	3.0	1,225	X
1942.....	.1	3.7	1,239	X
1943.....	.2	4.5	1,253	X
1944.....	.2	6.1	1,267	X
1945.....	.3	8.0	1,288	X
1946.....	.6	13.9	1,302	X
1947.....	1.3	21.3	1,315	X
1948.....	2.3	24.8	1,336	X
1949.....	3.8	26.6	1,350	X
1950.....	5.5	29.5	1,454	1,639
1951.....	7.6	32.4	1,516	1,776
1952.....	11.0	33.7	1,565	1,803
1953.....	15.0	37.9	1,620	1,848
1954.....	18.6	42.9	1,634	1,872
1955.....	23.0	48.2	1,641	2,050
1956.....	28.7	56.1	1,655	2,185
1957.....	32.2	63.8	1,662	2,278
1958.....	30.2	66.9	1,675	2,339
1959.....	30.9	74.8	1,682	2,470
1960.....	40.5	89.1	1,689	2,586
1961.....	52.1	99.7	1,696	2,602
1962.....	65.4	114.5	1,703	2,709
1963.....	80.0	133.9	1,703	2,855
1964.....	95.0	155.5	1,710	3,016
1965.....	108.3	175.4	1,772	3,154
1966.....	121.3	195.0	1,821	3,313
1967.....	137.6	219.9	1,869	3,420
1968.....	156.8	246.5	1,918	3,595
1969.....	181.9	274.3	1,925	3,808
1970.....	206.6	299.9	1,883	4,116
1971.....	226.9	321.8	1,869	4,267
1972.....	255.8	349.9	1,855	4,435
1973.....	292.4	387.3	1,835	4,678
1974.....	321.4	418.6	1,835	4,684
1975.....	310.9	404.1	1,835	4,660
1976.....	316.7	390.4	1,835	4,924
1977.....	303.9	371.2	1,828	5,065
1978.....	283.6	341.3	1,821	5,108
1979.....	263.7	337.5	1,814	5,345
1980.....	250.8	332.5	1,807	5,255
1981.....	248.2	240.7	X	5,115
1982.....	239.5	337.4	X	5,079

ANNUAL EMISSIONS OF ENVIRONMENTALLY IMPORTANT TRACE GASES, 1925-85—Continued

Year	Chlorofluorocarbons (thousand metric tons)		Carbon dioxide (million metric tons of carbon)	
	CCl ₃ F (CFC-11)	CCl ₂ F ₂ (CFC-12)	Biotic sources	Fossil fuel combustion and industrial processes
1983.....	252.8	343.3	X	5,068
1984.....	271.1	359.4	X	5,252
1985.....	280.8	368.4	X	¹ 5,400

¹ Preliminary. 0 = zero or less than half the unit measure. X = Not available.

Source: Chemical Manufacturers Association; Ecological Monographs; and University of New Orleans.

ATMOSPHERIC CONCENTRATIONS OF ENVIRONMENTALLY IMPORTANT TRACE GASES, 1959-86

	Parts per million, CO ₂	Parts per trillion—				Parts per billion	
		CCL ₄	CH ₃ CCl ₃	CCl ₃ F (CFC-11)	CCl ₂ F ₂ (CFC-12)	N ₂ O	CH ₄
1959.....	316.1	X	X	X	X	X	X
1960.....	317.0	X	X	X	X	X	X
1961.....	317.7	X	X	X	X	X	X
1962.....	318.6	X	X	X	X	X	X
1963.....	319.1	X	X	X	X	X	X
1964.....	319.6	X	X	X	X	X	X
1965.....	320.4	X	X	X	X	X	X
1966.....	321.1	X	X	X	X	X	X
1967.....	321.8	X	X	X	X	X	X
1968.....	322.8	X	X	X	X	X	X
1969.....	324.2	X	X	X	X	X	X
1970.....	325.5	X	X	X	X	X	X
1971.....	326.5	X	X	X	X	X	X
1972.....	327.7	X	X	X	X	X	X
1973.....	329.8	X	X	X	X	X	X
1974.....	330.4	X	X	X	X	X	X
1975.....	331.0	104	70	120	200	291.4	1,525
1976.....	332.1	106	78	133	217	293.3	1,555
1977.....	333.6	115	86	148	239	294.6	1,573
1978.....	335.2	123	94	159	266	296.4	1,596
1979.....	336.6	116	112	167	283	296.3	1,619
1980.....	338.4	121	126	179	307	297.6	1,639
1981.....	339.5	122	127	185	315	298.5	1,656
1982.....	340.7	121	133	193	330	301.0	1,671
1983.....	342.7	126	144	205	350	300.9	1,663
1984.....	344.3	130	150	213	366	300.4	1,689
1985.....	345.6	130	158	223	384	301.5	1,711
1986.....	¹ 346.7	X	X	X	X	X	X

¹ Estimated from January-October monitoring data. X = Not available.

Source: Scripps Institute of Oceanography; and Science.

Mr. STAFFORD. Mr. President, tomorrow I will discuss briefly the roll of the most common of our air pollutants—carbon dioxide.

SEPTEMBER 15, 1988

ATMOSPHERIC CONTAMINATION—IV

Mr. STAFFORD. Mr. President, as light speeds from the Sun toward Earth, it travels 93 million miles without undergoing any significant change. The instant it touches the Earth's surface, however, the light changes form.

The impact of the light on the soil or water is enough to generate heat. Much of this heat is reflected back toward space as infrared radiation, including the heat that is trapped by the gases that form our atmosphere.

This circumstance has been called the greenhouse effect because the glass panels in hothouses work very much the same way, trapping solar heat before it has a chance to escape.

The amount of heat that is trapped can vary because of different circumstances. The temperature on Earth fluctuates over thousands of years and even daily. But it does so very slowly over the long run.

At one time, ice covered the United States almost as far south as Florida. At another time, oceans covered Wyoming, leaving behind rich deposits of oil, gas, and coal. Those changes in climate were slow enough to allow plants and animals to move with them and adapt.

The gradual temperature fluctuations are the result of natural swings in the Earth's orbit around the Sun. As the Earth moves farther away from the Sun, the planet cools, bringing on an ice age. As it once again moves nearer to the Sun, the ice age ends with a period of warming.

Scientists tell us this runs in cycles of 10,000 to 12,000 years each and that in the last 1 million years, 900,000 years have been cold and 100,000 years have been warm. It appears life on Earth may be better adapted to cold than heat.

Today, scientists are convinced global temperature is at or near its high point in a million years. Further, some scientists felt temperatures will soon approach levels higher than at any previous time.

The reason for this is air pollution.

The pollutants we are producing are trapping more and more heat in the Earth's atmosphere. These pollutants are carbon dioxide, chlorofluorocarbons or CFCs, better known to us as freons, nitrous oxide, methane and ground level ozone—we know as smog.

Unless action is taken to halt the rising tide of these pollutants, scientists warn that the planet's temperature will continue to rise to the point where it will be the same as if the Earth had moved 1 million miles closer to the Sun.

The signs are all about us. The Earth's temperature has risen 1 degree in the last century and sea levels have risen as well. The years 1980, 1981, 1983, and 1987 are the hottest 4 in recorded history, and 1988 promises to be hotter still.

Forest fires in our West have been the worst in history; glaciers have retreated in Alaska; red spruce are growing faster than before

without explanation, and warm water is believed to have killed coral in the Caribbean Sea.

Carbon dioxide is the air pollutant that traps most of the heat. Concentrations of carbon dioxide have been rising steadily from a natural level of about 275 parts per million to the current level of over 345 parts per million.

Less than half the carbon dioxide emitted remains in the air. Plants consume some. About 55 percent of it disappears into the oceans in some mysterious way. We do know, however, that as the air warms, so do the soils and the waters. And warm water cannot hold as much carbon dioxide as cold water. Also, as the soil warms, greater volumes of methane—natural gas—are released. It, too, is a greenhouse gas, and this will accelerate the warming trend.

The family of industrial chemicals known as chlorofluorocarbons, CFCs, is a major greenhouse pollutant. CFCs account for about one-fifth of the warming, mainly because CFCs last for as long as 150 years in the upper atmosphere.

Another major greenhouse pollutant is ground level ozone, which we often call smog. Smog is formed when hydrocarbons, like unburned gasoline and oxides of nitrogen react in the presence of sunlight. With the high temperatures of the 1980's have come the highest smog levels in the country since the 1970's.

We cannot allow these circumstances to continue.

Mr. President, I ask unanimous consent that some tables and other materials that I offer be printed in the Record.

CARBON DIOXIDE IN THE ATMOSPHERE, 1958-85

Average annual concentrations of carbon dioxide (Parts per million, volume basis)								
Barrow, Alaska (71°N)		Mauna Loa, Hawaii (20°N)		American Samoa (14°S)		South Pole (90°S)		
Concentration	Annual increase	Concentration	Annual increase	Concentration	Annual increase	Concentration	Annual increase	
1958.....	X	X	X	X	X	X	315.4	X
1959.....	X	X	316.1	X	X	X	315.4	0.9
1960.....	X	X	317.0	0.9	X	X	316.7	1.3
1961.....	X	X	317.7	.7	X	X	317.5	.8
1962.....	X	X	318.6	.9	X	X	318.0	.5
1963.....	X	X	319.1	.5	X	X	318.2	.2
1964.....	X	X	319.6	.5	X	X	318.3	.1
1965.....	X	X	320.4	.8	X	X	319.3	1.0
1966.....	X	X	321.1	.7	X	X	320.6	1.3
1967.....	X	X	321.8	.7	X	X	321.2	.6
1968.....	X	X	322.8	1.0	X	X	321.8	.6
1969.....	X	X	324.2	1.4	X	X	322.6	.7
1970.....	X	X	325.5	1.3	X	X	324.2	1.6
1971.....	X	X	326.5	1.0	X	X	325.0	.8
1972.....	X	X	327.7	1.3	X	X	325.8	.8
1973.....	X	X	329.7	2.0	X	X	327.4	1.7
1974.....	332.6	X	330.4	.7	X	X	328.3	.9
1975.....	333.4	0.8	331.0	.6	X	X	329.3	1.0
1976.....	333.7	.3	332.1	1.1	331.2	X	330.4	1.1
1977.....	334.6	.9	333.6	1.5	332.6	1.4	331.9	1.4
1978.....	336.7	2.1	335.2	1.6	X	X	333.5	1.6
1979.....	337.9	1.2	336.6	1.4	336.1	X	334.9	1.3
1980.....	339.9	2.0	338.4	1.7	338.0	1.9	336.8	1.9
1981.....	341.7	1.8	339.5	1.1	339.2	1.2	338.1	1.3
1982.....	342.8	1.1	340.7	1.3	340.2	1.0	349.2	1.1
1983.....	343.8	1.0	342.7	2.0	341.4	1.2	341.0	1.8

CARBON DIOXIDE IN THE ATMOSPHERE, 1958-85—Continued

Average annual concentrations of carbon dioxide (Parts per million, volume basis)								
	Barrow, Alaska (71°N)		Mauna Loa, Hawaii (20°N)		American Samoa (14°S)		South Pole (90°S)	
	Concentration	Annual increase	Concentration	Annual increase	Concentration	Annual increase	Concentration	Annual increase
1984.....	346.0	2.2	344.4	1.7	343.0	1.6	342.4	1.4
1985.....	X	X	345.6	1.3	X	X	X	X

X = Not available.

Sources: Scripps Institution of Oceanography; U.S. National Oceanic and Atmospheric Administration.

GLOBAL CARBON DIOXIDE EMISSIONS FROM ANTHROPOGENIC SOURCES, 1950-84

	Carbon emissions (million metric tons of carbon)						
	Total	Fossil fuel combustion			Natural gas	Other industrial sources	
		Total	Solid fuels	Liquid fuels		Gas flaring	Cement production
1950	1,639	1,598	1,078	423	97	23	18
1951	1,776	1,731	1,137	479	115	24	21
1952	1,803	1,755	1,127	504	124	26	22
1953	1,848	1,797	1,133	533	131	27	24
1954	1,872	1,818	1,123	557	138	27	27
1955	2,050	1,990	1,215	625	150	30	30
1956	2,185	2,121	1,281	679	161	32	32
1957	2,278	2,209	1,317	714	178	35	34
1958	2,339	2,268	1,344	732	192	35	36
1959	2,470	2,394	1,390	790	214	36	40
1960	2,586	2,504	1,419	850	235	39	43
1961	2,602	2,515	1,356	905	254	41	46
1962	2,709	2,616	1,358	981	277	44	49
1963	2,855	2,756	1,403	1,053	300	47	52
1964	3,016	2,908	1,442	1,138	328	51	57
1965	3,154	3,040	1,467	1,221	352	55	59
1966	3,313	3,190	1,485	1,325	380	60	63
1967	3,420	3,288	1,454	1,424	410	66	66
1968	3,595	3,452	1,455	1,552	445	73	70
1969	3,808	3,654	1,493	1,674	487	80	74
1970	4,116	3,950	1,595	1,839	516	88	78
1971	4,267	4,093	1,594	1,946	553	90	84
1972	4,435	4,250	1,612	2,056	582	95	90
1973	4,678	4,470	1,622	2,240	608	102	96
1974	4,684	4,481	1,620	2,245	616	107	96
1975	4,660	4,468	1,715	2,132	621	96	96
1976	4,924	4,712	1,754	2,313	645	110	102
1977	5,065	4,848	1,812	2,390	646	108	109
1978	5,108	4,885	1,828	2,384	673	106	117
1979	5,345	5,152	1,899	2,538	715	74	119
1980	5,255	5,056	1,924	2,408	724	78	121
1981	5,115	4,935	1,928	2,274	733	58	122
1982	5,079	4,901	1,983	2,184	734	56	122
1983	5,054	4,880	1,985	2,164	731	52	122
1984 ¹	5,330	5,155	2,103	2,268	784	47	129

¹ Preliminary.

Source: Institute for Energy Analysis, Oak Ridge Associated Universities.

CARBON DIOXIDE EMISSIONS, BY COUNTRY AND REGION, 1950, 1965, and 1983

	Carbon emissions from fossil fuel consumption														
	1950 (million metric tons of carbon)					1965 (million metric tons of carbon)					1983 (million metric tons of carbon)				
	Solid	Liquid ²	Gas	Total	Percentage of world total	Solid	Liquid	Gas	Total	Percentage of world total	Solid	Liquid	Gas	Total	Percentage of world total
World.....	1,072	385	96	1,553	100.0	1,464	1,118	347	2,929	100.0	2,017	2,028	738	4,783	100.0
North America.....	376	259	88	723	46.6	318	447	238	1,003	34.2	432	553	260	1,245	26.0
United States.....	347	245	87	679	43.7	301	406	228	935	31.9	405	500	233	1,138	23.8
Canada.....	29	14	1	44	2.8	17	41	10	68	2.3	27	53	27	107	2.2
Western Europe.....	336	40	1	377	24.3	358	274	11	643	22.0	272	369	112	753	15.7
United Kingdom.....	125	11	X	136	8.8	117	52	<1	169	5.8	68	45	28	141	2.9
France.....	46	9	<1	55	3.5	49	42	3	94	3.2	30	59	14	103	2.2
German, Federal Republic.....	91	2	X	93	6.0	115	56	1	172	5.9	86	68	25	179	3.7
Italy.....	7	4	<1	11	.7	8	37	4	49	1.7	12	65	14	91	1.9
Other.....	66	15	<1	81	5.2	68	87	2	157	5.4	75	131	32	238	5.0
Eastern Europe.....	250	36	5	291	18.7	495	174	79	748	25.5	609	405	265	1,279	26.7
U.S.S.R.....	149	33	3	185	11.9	290	151	68	509	17.4	355	335	221	911	19.0
Poland.....	30	<1	<1	30	1.9	61	4	1	66	2.3	97	11	5	113	2.4
German Democratic Republic.....	43	X	X	43	2.8	79	3	X	82	2.8	64	13	5	82	1.7
Other.....	28	3	2	33	2.1	66	16	10	92	3.1	93	45	34	172	3.6
Pacific.....	40	5	X	45	2.9	66	71	1	138	4.7	92	173	22	287	6.0
Japan.....	26	1	1	27	1.7	45	55	1	101	3.4	61	148	15	224	4.7
Other.....	14	4	X	18	1.2	21	16	X	37	1.3	31	25	7	63	1.3
Centrally planned Asia.....	22	<1	X	22	1.4	134	11	1	146	5.0	403	73	6	482	10.1
China.....	21	X	X	21	1.4	120	10	1	131	4.5	365	69	6	440	9.2
Other.....	<1	X	X	X	X	14	2	X	16	.5	38	4	X	42	0.9
Developing world.....	48	45	2	95	6.1	93	141	17	251	8.6	209	456	73	738	15.4
Latin America.....	6	29	1	36	2.3	8	68	11	87	3.0	18	171	35	224	4.7
Africa.....	19	7	X	26	1.7	34	20	1	55	1.9	66	67	10	143	3.0
Middle East.....	2	2	X	4	.3	4	23	2	29	1.0	11	89	16	116	2.4
South and Southeast Asia.....	20	7	<1	27	1.7	47	29	3	79	2.7	114	129	11	254	5.3

X = Not available.

Source: Institute for Energy Analysis, Oak Ridge Associated Universities.

SEPTEMBER 16, 1988

ATMOSPHERIC CONTAMINATION—V

Mr. STAFFORD. Mr. President, few chemicals have enjoyed the success and popularity of chlorofluorocarbons, better known to most of the world as freons. And, for good reason.

Chlorofluorocarbons, CFCs for short, seem to be a miracle chemical. They are stable, nontoxic substances that can be put to thousands of different uses without fear that they will burn, explode, or poison anyone or anything.

In fact, they seem to have only one shortcoming—they destroy the ozone layer in the stratosphere that shields life on Earth from the deadly radiation of the Sun.

The ozone layer is often referred to as a shield, but it is in reality a zone about 35 kilometers thick in which ozone molecules are thinly spread. There are so few of these molecules of ozone that if they were compressed, the layer would be only as thick as a plastic trash bag—about 3 mils.

As thin as this layer may be, it is all that stands between life on Earth and the searing radiation of the Sun, which is mainly ultraviolet light. An unprotected cell exposed to ultraviolet light can be literally exploded on contact. Even filtered by the ozone shield, ultraviolet light is still potent enough to blister skin, disrupt plants, and destroy small marine organisms.

The Environmental Protection Agency (EPA) estimates that a 10-percent depletion of the ozone layer would cause nearly 1.9 million new cases of skin cancer a year, including 65,000 cases of melanoma, which is frequently fatal.

Scientists are also concerned that ultraviolet light might cause damaging changes to our biological ecosystems that sustain all life on Earth.

The ozone depletion theory was first advanced in 1974 by two California scientists, Drs. F. Sherwood Roland and Mario Molina, who concluded that CFCs released into the atmosphere cause the depletion.

That's bad news, because the ozone in the stratosphere screens out more than half of the ultraviolet radiation that would otherwise reach the surface of the Earth.

Roland and Molina found that CFCs survive all of the destruction processes found at lower levels, but are shattered by the ultraviolet light when they reach the stratosphere. The chlorine atoms that are freed by the destruction of the CFCs then go to work destroying ozone molecules.

Since CFCs have a life of up to 150 years, which means that, even if we had heeded the 1974 warning of Roland and Molina, we would still face more than a century of ozone depletion.

But, we would not have been prepared for the surprise that astounded even our best scientists.

Even those most perceptive scientists who agreed with the ozone depletion findings of Roland and Molina anticipated a slow reaction rate in gas phase chemistry of the atmosphere.

But, the extreme cold of the Antarctic—the coldest place on our planet—froze the water vapor in the air and formed clouds of ice particles in the stratosphere. These are known as polar stratospheric clouds and their ice particles provided a solid medium that vastly increased the speed of the reaction between the chlorine and ozone.

Thus, the clouds made possible the runaway reaction that created the huge hole in the ozone layer over the Antarctic. Once again, we have been reminded that nature does not always behave as mankind would like it to.

Although there were early doubters of the Roland and Molina findings, there is now virtually no doubt that CFCs do destroy the ozone layer and that a runaway reaction happened over the Antarctic because of the extreme cold. A question that remains is whether such runaway reactions may occur elsewhere.

I will describe evidence in future talks that this may, indeed, be taking place at this instant—not thousands of miles away in the Antarctic, but in my home State of Vermont and throughout the rest of the Appalachian chain of mountains and the States in which they are situated.

Mr. President, I ask unanimous consent that a chart showing production and release of chlorofluorocarbons from 1931 to 1984 be printed in the Record.

PRODUCTION AND RELEASE OF CHLOROFLUOROCARBONS, 1931-84

(In thousand metric tons)

	CFC-11		CFC-12	
	Production	Release	Production	Release
1931.....	0	0	0.5	0.1
1936.....	.1	0	1.7	.5
1941.....	3	.1	6.3	3.0
1946.....	.7	.6	16.6	13.9
1951.....	9.1	7.6	36.2	32.4
1956.....	32.5	28.7	68.7	56.1
1960.....	49.7	40.5	99.4	89.1
1961.....	60.5	52.1	108.5	99.7
1962.....	78.1	65.4	128.1	114.5
1963.....	93.3	80.0	146.4	133.9
1964.....	111.1	95.0	170.1	155.5
1965.....	122.8	108.3	190.1	175.4
1966.....	141.0	121.3	216.2	195.0
1967.....	159.8	137.6	242.8	219.9
1968.....	183.1	156.8	267.5	246.5
1969.....	217.3	181.9	297.3	274.3
1970.....	238.1	206.6	321.1	299.9
1971.....	263.2	226.9	341.6	321.8
1972.....	306.9	255.8	379.9	349.9
1973.....	349.1	292.4	423.3	387.3
1974.....	369.7	321.4	442.8	418.6
1975.....	314.1	310.9	381.0	404.1
1976.....	339.8	316.7	410.7	390.4
1977.....	320.5	303.9	382.8	371.2
1978.....	308.9	283.6	372.1	341.3
1979.....	289.5	263.7	357.2	337.5
1980.....	289.6	250.8	350.2	332.5
1981.....	286.9	248.2	351.3	340.7

PRODUCTION AND RELEASE OF CHLOROFLUOROCARBONS, 1931-84—Continued

[In thousand metric tons]

	CFC-11		CFC-12	
	Production	Release	Production	Release
1982.....	271.4	239.5	328.0	337.4
1983.....	291.7	252.8	335.3	343.3
1984.....	312.4	271.1	382.1	359.4

Q=Zero, or less than 90 metric tons.

Note: For additional information, see Sources and Technical Notes.

Source: Chemical Manufacturers Association.

SEPTEMBER 19, 1988

ATMOSPHERIC CONTAMINATION—VI

Mr. STAFFORD. Mr. President, there is now widespread scientific agreement that the ozone layer in the stratosphere that shields life on Earth from the deadly radiation of the Sun is being destroyed by the family of chemicals known as chlorofluorocarbons, CFCs or freons to most of us.

We use these chemicals as cleaning agents in our electronics industry; as refrigerants for our air-conditioners, and as blowing agents in the manufacture of building board and styrofoam cups. In all of these uses, CFCs are released into our atmosphere and live there for as long as 150 years.

The chlorine released from the breakdown of the CFCs in the stratosphere destroys the ozone that protects us. Most scientists now agree that this happens. And, most scientists, until lately, agreed that one chlorine molecule would destroy an ozone molecule every minute until the chlorine finally fell to Earth.

But, at the Antarctic, where polar stratospheric clouds have been formed because of the extreme cold temperatures that freeze water vapor in the air, the reaction between chlorine and ozone takes place literally 10 times faster than once a minute.

The result has been the total destruction of available ozone and the opening of an ozone layer hole the size of North America. The recent discovery of the ozone hole took the world's scientific community by surprise and we still don't have a full explanation.

Even the scientists who originally discovered depletion of the ozone layer by CFCs are not sure of the actual reason for the ozone hole, but they and other scientists are seeking an answer to two questions right now:

First, could the reaction at the Antarctic happen elsewhere?

And, second, even if it could not, what does it mean to us?

A scientific panel appointed to seek the answers to those and other questions reported in March of 1988 and gave partial answers to the two questions.

The scientists say that reactions similar to those at the Antarctic are possible. Scientists have measured depletions in the Northern Hemisphere that they believe are caused by chemistry like that associated with polar stratospheric clouds.

The answer to the second question is that, even if a second ozone hole does not appear anywhere else—the Antarctic hole is enough of a threat to keep us awake at night.

Scientists have found ozone depletion of 5 percent throughout the year in the Southern Hemisphere and they think this is the result of the impact of the Antarctic ozone hole. The southern half of the world is flooded with air that has been exhausted of its chlorine because of the Antarctic circumstance. There is no end in sight to this condition unless we change our ways—and even then existing CFCs in the atmosphere will live on for more than a century.

So, there we have it.

There is evidence that circumstances similar to those that have created the ozone hole at the Antarctic exist today in the Northern Hemisphere.

And, there is also evidence that the ozone layer in the Southern Hemisphere has been damaged disproportionately by the chemistry that has caused the ozone hole in the Antarctic.

In each case, there can be no doubt that man has become a rival of nature and evolution. What has been created by forces long thought of as vastly greater than those of the human race can now be undone—and with something as seemingly inconsequential as a hair spray can powered by CFCs.

Even if we halted all releases of CFCs into the atmosphere today, we would still feel the adverse impact of those releases for at least another century—for that is the lifespan of CFCs.

But, we continue to use CFCs in this country and around the globe. We are continuing to deplete the ozone layer that protects all human life on this planet. We are continuing to gamble with our very existence.

I hope to discuss in the future the Montreal protocol, a proposed international agreement designed to control and reduce production of CFCs.

But, before I do that, tomorrow I would like to examine a more conventional pollutant—sulphur dioxide—and its role in killing the lakes, streams, forests, and people of the United States.

Mr. President, again I thank the distinguished manager of the bill on our side for the time, and I yield the floor.

SEPTEMBER 20, 1988

ATMOSPHERIC CONTAMINATION—VII

Mr. STAFFORD. Mr. President, the evidence is in. Atmospheric contamination has killed the spruce and fir trees on the peak of Mount Mitchell in North Carolina, just as it has killed the forests on the peak of Camels Hump in my own State of Vermont.

We can argue whether the killer pollution has been acid rain or ozone, or a combination of the two with other pollutants. But, there is no longer any credible dispute that acid deposition is causing massive damage throughout North America and Europe.

Mount Mitchell is the highest point east of the Rockies. Located about 45 minutes from Asheville, the mountain is a protected wilderness area remote from any industrial center.

Because it is so remote and so protected, scientists have been monitoring the air quality there for years. This spring and summer they found that, for 3 months, the mountain was bathed in clouds as acid as lemon juice and vinegar. And, ozone levels were high. Similar conditions exists at six other mountains along the Black Mountain range.

Dr. Robert Bruck, who reported on these events, said that in 1984, less than 1 percent of the trees were dead. The death rate of trees on Mount Mitchell has risen sharply, as it had all along the ridge, through last year. Then, on July 19, 1988, he reported, the death rate was greater than 99 percent—and that went for all seven mountains on the ridge that he has studied.

The news is even worse than that. The soil itself has been poisoned in the area. Lead levels in the soils are 150 times greater than in the soil below. The aluminum levels are thousands of times greater.

The damage was inflicted by contamination of the atmosphere.

Acid rain is caused by oxides of sulphur dioxide and nitrogen, which are converted into sulfuric and nitric acids after they've been in the air for a few hours or a few days. Levels of both sulphur dioxide and oxides of nitrogen have declined from the historic highs of the 1970's, but there levels remain high enough to constitute threats to human health and the environment.

The rain that falls through the Eastern United States and much of the West, as well, is at least 5 times as acidic than normal—and it may be 10 or 15 times as high.

The result is that lakes and streams have become more acidic and they have been damaged to the extent that—in too many cases—they can no longer sustain plant and fish life.

And, it is not only plants and fish that have suffered.

While we still do not have all the answers, scientists tell us when acid-based air pollution increases, so do the rates of wintertime illnesses and mortality of humans. The soup of air pollutants that is becoming all too common in this country injures the health not only of the very young and the very old and those with respiratory diseases, but also those who are healthy and strong.

More than 35 million Americans live in dirty air areas of this Nation that not only do not meet existing air quality standards, but where the air quality has declined since 1981. More than 100 million Americans are breathing air that does not meet the Federal health standards.

In addition, researchers have demonstrated adverse health effects of levels of exposure to air previously presumed to be safe. Pediatricians have told us that we should reduce the levels of sulphur dioxide and oxides of nitrogen to prevent continued injury to healthy infants.

Each and every year, for 20 to 40 years, this Nation has produced up to 400 pounds of sulphur and nitrogen oxide for every man, woman, and child in the country. It is unlikely that either the people of this Nation or our environment can continue to absorb that level of insult to our well-being.

The danger to the health of Americans is serious and pervasive. There is no choice but to breathe the air—whether it is clean or dirty. We know it is too dirty in too many places, and the evidence is compelling that we are long past the time when action is necessary.

Mr. President, I ask unanimous consent that a variety of materials be printed in the Record.

The ACTING PRESIDENT *pro tempore*. Without objection, it is so ordered.

COMPARISON OF AIR POLLUTION LEVELS AND DEPOSITION RATES BETWEEN FORESTED AREAS IN WEST GERMANY AND THE UNITED STATES

Pollutant	Averaging period	Germany ¹	United States ²
Ozone (ppb)	Annual average	36-48	40-50
	Maximum peak	115-180	85-120
Precipitation (pH)	Annual average	4.2-4.6	4.2-4.7
Cloud events (pH)	Maximum observed pH		2.2-2.8
Total sulfate deposition (wet and dry) (kg/ha-Yr)	Annual	70-125	100-400
Nitrate deposition (wet only) (kg/ha-Yr)	Annual	22-48	60-200

¹ Forested areas showing decline symptoms in southern Germany.

² Various mountains in the eastern United States where tree damage is being observed.

Sources: From various tables, "Acid Deposition Studies," Ebasco Services Inc., prepared for the Business Roundtable Environment Task Force (New York: Ebasco 1986); "Exposure of Forests to Gaseous Air Pollutants and Clouds," Mountain Cloud Chemistry Project, Volker A. Mehnen, June 1987; "Technical Report, Spruce-Fir Research Cooperative," March 1988.

1986 FOREST DAMAGE IN WEST GERMANY BY SPECIES AND DAMAGE CLASS

[In percent]

Damage stage	Spruce	Pine	Fir	Beech	Oak	Other	Total
Undamaged	45.9	46.0	17.1	39.9	39.3	65.8	46.3
Slightly damaged	32.4	39.5	22.5	41.2	41.2	24.5	34.8
Moderately damaged	20.1	13.1	49.1	17.5	18.7	8.5	17.3
Seriously damaged or dead	1.6	1.4	11.4	1.4	0.8	1.2	1.6
All damage classes	54.1	54.0	82.9	60.1	60.7	34.2	53.7

Source: Waidschadensenheburg 1986, Bundesministerium fuer Ernährung, Landwirtschaft and Forsten, Table 5.

Mr. STAFFORD. Mr. President, tomorrow I propose to discuss the role of oxides of nitrogen and ground level ozone in our continuing examination of atmospheric contamination.

SEPTEMBER 22, 1988

ATMOSPHERIC CONTAMINATION—VIII

Mr. STAFFORD. We generally think of smog as an urban air pollution problem, but the remarkable and unexpected fact of the matter is that ground level ozone concentrations have at least doubled in the last 100 years in the most unlikely places.

Scientists tell us that ozone levels in rural areas of Europe and even in the middle of the Pacific Ocean have doubled and tripled in the last century. We are beginning to pay more attention to levels

of ozone outside of our cities because our forest systems are beginning to die and also because ozone is a greenhouse gas.

At the ground level, ozone is formed when two pollutants—oxides of nitrogen and hydrocarbons—react in the presence of sunlight. Ozone is a powerful oxidizing agent—like bleach. It damages not only plant life, but also the cell walls of the human lung.

This has been a bad year of ozone in the United States. The worst previous year of ozone levels was 1983, but by last month the levels set in 1983 had already been broken at two out of every three monitoring stations in the country. At Acadia National Park in Maine, for example, there have already been six violations of the health standard for ozone this year. There was only one such violation last year.

It should come as no surprise that ozone levels are increasing. Ozone is formed from three ingredients—oxides of nitrogen, hydrocarbons, such as unburned gasoline, and the heat of the Sun. Since the levels of all three have been rising in the United States, so has the level of ozone.

Ozone in the lower atmosphere—called the troposphere—is a greenhouse gas, and a potent one, that contributes to global warming and climate change. It is also highly toxic to plant life. And, of course, it is part of the soup of air pollutants that includes acid rain.

So there it is—a multiple threat pollutant that is a direct hazard to human health and that is also linked to global warming, acid rain, and ecosystem collapse.

Adding to the considerable concern of scientists is that ozone levels, already dangerously high, have the potential to increase tenfold. The key ingredient in the formation of nonurban ozone is oxides of nitrogen. As they increase, so do ozone levels.

Yet, nowhere in the world, including the United States, is any systematic effort being made to halt the runaway growth in emissions of oxides of nitrogen. We temporarily capped that growth in this country with the auto tailpipe standards enacted in the 1970's, but the benefits of that program are now nearly exhausted. And we have no plans to enact strong controls for powerplants and large industrial sources.

Nitrogen oxide emissions in this country increased from less than 3 million tons in 1900 to about 20 million tons at the beginning of this decade. The growth in Europe has been even more dramatic. European emissions are 37 million tons annually, about 54 percent of the global total. And emissions in the developing nations, including China, are expected to skyrocket.

Only in Japan have nitrogen oxide emissions dropped substantially. The Japanese have reduced emissions 90 percent over the last 20 years through controls on motor vehicles and smokestacks.

Elsewhere in the world, the trend is depressing. Nitrogen oxide emissions are increasing and with them come increases in concentrations of ground-level ozone. This is happening despite the fact that we know how to control these emissions with relative ease and at small expense.

The technology is at hand and it has been demonstrated effective at hundreds of installations of utilities and other industries. We

seem to lack the understanding that we need to reduce these emissions before it is too late.

Tomorrow, I hope to discuss with you a variety of other air pollutants, including many that play a much more significant role in atmospheric contamination than is generally realized. Included among these are carbon monoxide and methane.

Madam President, I yield the floor.

SEPTEMBER 23, 1988

ATMOSPHERIC CONTAMINATION—IX

Mr. STAFFORD. Mr. President, this is the ninth in a series of short speeches of which there will be 16 altogether concerning atmospheric contamination.

Scientists know that 250 years ago, the concentration of methane in the atmosphere was seven-tenths of a part per million. It now stands at 1.7 parts per million, the highest level in at least 150,000 years, and possibly longer.

This is bad news for several reasons. First, methane is a greenhouse gas and additional methane in the atmosphere speeds up the global warming trend. Additionally, methane may also play a part in the destruction of the ozone layer in the stratosphere that protects us from radiation from the Sun.

The increase in the methane concentrations has been documented by analyses of ice core samples taken close to the North Pole in the Soviet Union. The increase in the last 250 years is probably due to population growth.

But the amount of methane that can be added to the atmosphere by human population growth, together with all the assorted herds of sheep and cattle and carefully tilled land, is microscopic when compared to the amounts that could be released all at once.

Each year for the last few hundred million years, at least, nature has laid aside a small fraction of biological activity as vegetable matter. This is stored in the frigid slopes of arctic tundra and other places, much like our reserves of coal, oil, and natural gas.

Some scientists now fear that the Earth is on the verge of becoming so warm that the tundra will thaw and release the stored methane over a span of only 50 to 100 years. Release of the methane at that rate would accelerate the global warming trend just as we have done by our rate of burning our coal, oil, and gas reserves.

That rate of release of methane may also play a role in the destruction of the ozone layer in the stratosphere for methane is converted into water after it rises slowly into the stratosphere. That water can provide a means for the formation of the polar stratospheric clouds that have been a catalyst in the runaway destruction of the stratospheric ozone layer at the Antarctic.

It would be just another example of the way we have been surprised by the unexpected in nature and in the kinds of interactions that result from atmospheric contamination.

Carbon monoxide, for example, is not usually thought of as a global climate change pollutant. It is a clear, odorless gas emitted mostly from cars and trucks. It is usually converted to carbon dioxide within minutes of leaving the tailpipe. But it is linked to climate change in an indirect manner.

The air abounds with a chemical called the hydroxyl radical, which reacts with a wide variety of other pollutants. It scavenges methane, for example, and also plays as a part in the formation of acid rain.

The hydroxyl radical reacts more readily with carbon monoxide than with any of these other pollutants.

So, when carbon monoxide concentrations increase—as they have been doing as far away as the Antarctic—the series of chemical reactions which holds methane, acid rain, and smog in check is upset in a way very difficult to predict.

Scientists admit they are confounded by the atmospheric chemistry that incorporates more than 200 reactions just to convert sulphur into sulfuric acid. Thus, they have great concern over the possible reactions that could result from increased releases of methane and carbon monoxide into our global atmosphere.

Some scientists believe that methane has started to be released from the frigid Arctic already, but we will not know for sure about that for some years to come. That is not the case with carbon monoxide. Every day the volume of carbon monoxide that is released into the atmosphere of the globe grows greater.

Once again we humans are at a point of decision about whether we will attempt to control the releases of these pollutants or whether we want to gamble with the consequences of inaction.

Monday, I will discuss the two principal sources of carbon dioxide and virtually all other air pollutants as well. I refer, of course, to the automobile and the electric powerplant.

SEPTEMBER 26, 1988

ATMOSPHERIC CONTAMINATION—X

Mr. STAFFORD. When it comes to atmospheric contamination, tailpipes and smokestacks—in that order—rule the world.

Motor vehicles generate more air pollution than any other single human activity. Electric utilities hold down second place by a wide margin. Nothing else comes close.

Cars and trucks are far and away the major source of carbon monoxide, oxides of nitrogen, and hydrocarbons. They are a significant source of carbon dioxide and, particularly in our country, of chlorofluorocarbons—CFCs or freons. All of these pollutants cause or contribute to the formation of ground level ozone. Some also destroy or contribute to the destruction of stratospheric ozone.

Throughout Europe, virtually all of the lead and carbon monoxide in cities, and an increasing proportion of the fine particles, originates with motor vehicles. Cars and trucks produce 50 to 70

percent of the oxides of nitrogen and 50 percent of the volatile organic chemicals, such as gasoline fumes.

The increases in the number of cars and in vehicle miles traveled are reducing the gains we have recorded from tailpipe exhaust standards set a decade ago. And, the growth in vehicles that took place in the United States and Europe during the last 35 years is now beginning to be recorded in the rest of the world.

This is probably due to a combination of increases in living standards and populated growth. Our global population by the year 2000 is expected to be double the 1960 total.

There were less than 50 million cars on this planet in 1950, and 85 percent of them were in North America. The auto population is now about 350 million, with 125 million of those outside North America. By the year 2000, it is expected there will be more than 500 million motor vehicles.

In addition to creating air pollution, motor vehicles in the United States are the single largest contributor to depletion of the ozone layer that protects us from the radiation of the Sun.

One out of every eight pounds of freons made in this country is used in cars and trucks for air conditioning—a total of 56,500 tons in 1985, for example. By contrast, home refrigerators used 3,800 tons that year.

In addition to those direct uses, chlorofluorocarbons are used as blowing agents to manufacture seat cushions and other foams in cars and trucks. About 20 percent of the flexible foams made from CFCs in the United States are destined for automobiles. And, of course, much of that chemical eventually is released into the air.

Cars and trucks also emit prodigious amounts of carbon dioxide, about 2.8 billion tons a year, or nearly one-quarter of the world total. Each tankful of gas that is burned produces between 300 and 400 pounds of carbon dioxide. At current growth rates, that emission total will quadruple by the year 2030.

Mr. President, I ask unanimous consent that some tables and an explanation of them be printed in the Record.

The ACTING PRESIDENT pro tempore. Without objection, it is so ordered.

EXPLANATION OF TABLES

The attached tables illustrate future growth in motor vehicle fuel consumption—and, therefore, carbon dioxide emissions—unless some action is taken.

Table I, which is based on data collected by the Motor Vehicle Manufacturers Association, shows the increase in the number of vehicle miles travelled in recent years. The number of vehicle miles travelled is increasing in all modes—cars, trucks, motorcycles, and buses—of transportation, although truck travel is rising at the sharpest rate. In 1987, the total number of vehicle miles travelled was just above 1.9 trillion.

Table II shows the amount of fuel consumed per year and by mode since 1940.

Table III projects that historic fuel consumption into the future, assuming there is an annual increase in the number of vehicle miles travelled of 2 percent per year. It also assumes that there is a 1 percent increase in fuel efficiency each year. Now that there is serious consideration given to relaxation of the Federal auto efficiency standards, it may be unrealistic to assume a 1 percent per year rise.

However, even if fuel efficiency does continue to grow, overall fuel consumption will still increase. This is because the number of vehicle miles travelled is rising at even sharper rate.

Finally, table IV shows that legislation now before the Committee on Environment and Public Works could reverse this trend in fuel consumption. The Stafford-

Baucus bill referred to is S. 2666. Other sponsors of that bill include Senators Chafee, Durenberger, Gore, Bumpers, and Reid.

Table IV shown that by the year 2030 the Stafford-Baucus bill will be achieving fuel savings of over 65 billion gallons of gasoline a year. The cumulative fuel savings by 2030 would be 1.4 trillion gallons of gasoline.

Since each gallon of gasoline creates about 22 pounds of carbon dioxide when it is burned, the fuel savings translate to total CO₂ emissions reductions of over 50 trillion pounds by the year 2030. Annual CO₂ savings would be about 1.4 trillion pounds per year.

These analyses of S. 2666 were prepared by Mr. Michael Walsh, who is a consultant to the Committee on Environment and Public Works as well as to the governments of Sweden, Austria, Mexico, Taiwan, and a number of other nations.

TABLE I.—VEHICLE MILES TRAVELED

(Millions)					
Year	Cars	MC	Buses	Trucks	All
1940.....	249,500		2,657	49,931	302,188
1950.....	363,613		4,081	90,552	458,246
1960.....	588,083		4,353	12,409	718,845
1965.....	709,300		4,684	173,656	887,640
1970.....	916,700	2,979	4,544	185,501	1,109,724
1975.....	1,033,950	5,629	6,055	282,030	1,327,664
1980.....	1,111,596	10,214	6,059	399,426	1,527,295
1984.....	1,224,919	8,784	4,640	481,926	1,720,269
1985.....	1,260,565	9,086	4,876	499,652	1,774,179
1986.....	1,303,507	9,414	5,087	520,232	1,838,240
1987.....					1,908,885

Source: Walsh—Derived From MVMA 1988.

TABLE II.—FUEL CONSUMED

(Millions of gallons)					
Year	Cars	MC	Buses	Trucks	All
1940.....	16,323		436	5,156	21,915
1950.....	24,305		732	10,566	35,603
1960.....	41,169		827	15,882	57,878
1965.....	49,723		875	20,506	71,104
1970.....	67,820	60	820	23,630	92,330
1975.....	76,447	113	1,053	31,371	108,984
1980.....	71,883	204	1,018	41,854	114,959
1984.....	68,717	176	793	490,050	118,736
1985.....	69,268	182	835	51,037	121,322
1986.....	71,162	188	891	52,943	125,184
1987.....					126,843

Source: Walsh—Derived From MVMA 1988.

TABLE III.—U.S. AUTO FUEL CONSUMPTION (BILLION GALLON) 2 PERCENT VMT GROWTH PER YEAR

Year	Base ¹	Stafford/Baucus bill
1985.....	68	68
1986.....	67	67
1987.....	66	66
1988.....	66	66
1989.....	66	66
1990.....	66	66
1991.....	66	66
1992.....	67	66
1993.....	68	67

TABLE III.—U.S. AUTO FUEL CONSUMPTION (BILLION GALLON) 2 PERCENT VMT GROWTH PER YEAR—Continued

Year	Base ¹	Stafford/Baucus bill
1994.....	69	68
1995.....	70	68
1996.....	71	67
1997.....	72	67
1998.....	73	67
1999.....	74	67
2000.....	75	65
2001.....	76	63
2002.....	77	61
2003.....	78	60
2004.....	79	58
2005.....	80	57
2006.....	81	55
2007.....	82	55
2008.....	83	54
2009.....	84	54
2010.....	85	51
2011.....	85	48
2012.....	86	46
2013.....	87	44
2014.....	88	42
2015.....	89	40
2016.....	90	38
2017.....	91	37
2018.....	92	36
2019.....	92	35
2020.....	93	34
2021.....	94	34
2022.....	95	34
2023.....	96	34
2024.....	97	34
2025.....	98	35
2026.....	99	35
2027.....	100	36
2028.....	101	36
2029.....	102	37
2030.....	103	37

¹ Assumes 1 percent MPG improvement per year.

Source: Walsh Sept. 20, 1988.

TABLE IV.—U.S. FUEL SAVINGS FROM STAFFORD-BAUCUS BILL, 2 PERCENT VMT GROWTH, 1 PERCENT MPG GAIN POST-1995

Year	Savings (annual)	Billion gal/year cumulative)
1990.....	0.20	0.20
1991.....	.38	.59
1992.....	.58	1.17
1993.....	.77	1.94
1994.....	.96	2.90
1995.....	2.39	5.29
1996.....	3.72	9.01
1997.....	4.97	13.98
1998.....	6.10	20.08
1999.....	7.11	27.18
2000.....	10.29	37.47
2001.....	13.31	50.78
2002.....	16.18	66.95

TABLE IV.—U.S. FUEL SAVINGS FROM STAFFORD-BAUCUS BILL, 2 PERCENT VMT GROWTH, 1 PERCENT MPG GAIN POST-1995—Continue

Year	Savings (annual)	Billion gal/year cumulative
2003.....	18.85	85.81
2004.....	21.32	107.13
2005.....	23.53	130.66
2006.....	25.47	156.12
2007.....	27.20	183.32
2008.....	28.70	212.02
2009.....	29.95	241.97
2010.....	33.69	275.66
2011.....	37.12	312.78
2012.....	40.39	353.17
2013.....	43.46	396.63
2014.....	46.34	442.97
2015.....	48.99	491.97
2016.....	51.45	543.42
2017.....	53.73	597.15
2018.....	55.79	652.93
2019.....	57.61	710.54
2020.....	59.02	769.57
2021.....	60.16	829.72
2022.....	61.15	890.88
2023.....	62.02	952.90
2024.....	62.77	1,015.67
2025.....	63.42	1,079.09
2026.....	63.99	1,143.08
2027.....	64.69	1,207.58
2028.....	64.95	1,272.52
2029.....	65.36	1,337.89
2030.....	65.64	1,403.52

Source: Walsh—Sept. 20, 1988.

Mr. STAFFORD. Mr. President, while motor vehicles are the dominant source of total air pollution in the United States, electric powerplants are the major source of all the pollution that is pumped into our air through the smokestacks of American industry and commerce.

Total emissions of oxides of nitrogen in the United States in 1986 were calculated at 19.3 million tons. All smokestacks contributed more than half of that total—10 million tons. The major source of that smokestack pollution was electric utilities, with 6.6 million tons of oxides of nitrogen pumped into the air. That is about 34 percent of the national total and two-thirds of the smokestack total.

Utilities are estimated to have contributed, in 1986, about 35 percent of all carbon dioxide emissions in the United States. That was about half of all the carbon dioxide emitted by smokestacks of all sorts in this country.

If we have any hope of reducing the air pollutants that are causing global climate changes, clearly we must focus on cars and powerplants. That does not mean we have to become pedestrians and eat cold food in the dark.

More than two-thirds of the coal, oil, and gasoline used to fuel our powerplants and motor vehicles is wasted because of the inefficiency of our technology. I will discuss this issue in more detail in

the future, but clearly our struggle to clean our air must begin with tailpipes and smokestacks.

Tomorrow, I plan to discuss an obvious fact in what will be the 11th of these 16 5-minute discussions. That fact is that pollution is dangerous to all living things. In fact, air pollution is a killer.

SEPTEMBER 27, 1988

ATMOSPHERIC CONTAMINATION—XI

Mr. STAFFORD. Mr. President, one of the things that is most contrary about air pollution is that it is often most dangerous just when you want to be outside breathing it. Ground level ozone concentrations, for instance, are at their highest on bright and sunny summer afternoons.

That is bad enough. What is worse is that we have recently received new information that suggests that this ozone—or smog—is more dangerous to our health than previously thought.

About 2 months ago, scientists from all parts of the world released new data on the health effects of smog. Their studies demonstrate that, in many respects, breathing the air that prevails about half the time in the Eastern United States and nearly all the time in California during the ozone seasons is about the same as smoking tobacco.

That's because ozone breaks down the cell walls of our lungs; decreases our ability to breathe, and disrupts the normal pattern of our heartbeat.

Another problem is that the damage gets worse as the concentration of ozone increases, and also that the damage gets worse the more an individual exercises. That means the Saturday bicycle ride or the afterschool pickup ball game during the ozone season is hazardous to the health of Americans of all ages.

I am not talking about laboratory experiments. These are real-world circumstances. During the week of June 13 of this year, for instance, air in the Baltimore-Washington area violated the ozone health standard by more than 50 percent on 4 out of 5 days. At the same time, areas of Wisconsin violated the standard 8 days in a row.

And, do not forget, ozone is not the only pollutant in the air. There are also oxides of nitrogen, sulphur dioxide, and a wide variety of other pollutants not present in laboratory tests.

A study of children at a New Jersey summer camp revealed that the youngsters were regularly breathing air that violated the workplace standard under the Occupational Health and Safety Administration rules. If the youngsters had been workers at their summer camp, the exposures would have been declared unsafe as a matter of Federal law, even though the standards of the Environmental Protection Agency were never violated.

We have also learned that more damage is caused to health by repeated short bursts of exposure to ozone than by single, continuous doses. And, of course, ozone occurs in the real world in waves

that come and go on tides of high pressure air. Just the way that is most damaging to our health.

Public health scientists have told the Congress that air pollution is the third leading cause of lung disease in the United States, exceeded only by active and passive cigarette smoking.

That should not come as too much of a surprise when we consider that more than 35 million Americans live in parts of this country where the air quality not only fails to meet the standards—but where that air has become more unhealthy than it was in 1981.

More than 100 million Americans—mostly in metropolitan areas—are breathing air that does not meet the Federal health-based air quality standards. About the only thing we have done about that lately is to extend the deadlines for achieving healthy air. That means those Americans will continue to breathe dirty air—but it will be legal.

It will also be hazardous to their health. And, it will be costly to this Nation. The American Lung Association estimates the costs of air pollution at \$40 billion annually.

And, a Harvard scientist estimates that air pollution could be causing more than 50,000 excess deaths each year in this country. That estimate was challenged by polluting industries, but none of the scientists invited to submit disagreeing testimony were willing to do so.

That tide of evidence is growing in force and in volume. Air pollution causes health problems that are serious and pervasive. Ozone at the ground level is a major and dangerous pollutant. We are running out of places to hide and out of time to act.

I ask unanimous consent to have some material printed in the Record.

There being no objection, the material was ordered to be printed in the Record, as follows:

U.S. ENVIRONMENTAL PROTECTION AGENCY,
Washington, DC, August 18, 1988.

Note to Lee Thomas.

Subject: Update of 1988 Ozone Concentrations through August 12, 1988.

The National Air Monitoring Stations (NAMS) coordinators have updated the earlier nationwide survey of this summer's ozone season. Most of the data are current through August 12. The number of monitoring sites participating in the survey has increased from 96 to 209. Most of the participating monitors are located in Regions I, II, III and IV (179 out of 209 monitors) but the major areas in all Regions are represented. In general, the monitors selected for the study are those with the highest readings. In order to expedite the reporting of the ozone data, it must be clearly understood that the data has not gone through the normal validation process.

The 1988 ozone data has been compared to 1987 and then to 1983, regarded by many as the worst year for ozone pollution. The last four columns show the net change in peak concentrations for each monitor location from 1983 to 1988 and 1987 to 1988.

The following observations can be made:

Nationally, 1988 peak concentration levels reported so far already exceed 1987 levels at 154 out of 199 sites (77 percent).

Compared with 1983, Nationally, the 1988 peak concentrations reported so far already exceed the 1983 levels at 116 out of 176 sites (65 percent).

The increases are particularly evident in the Northeast (EPA Regions I and II), the mid-Atlantic States (EPA Region II), the southeast (EPA Region IV) and the Great Lakes States (EPA Region V). Of the 147 selected monitoring sites in these combined Regions, 1988 peak levels exceed the 1987 levels at 140 out of 170 sites (82 percent) and exceed the 1983 levels at 107 of 147 sites (72 percent).

Major increases in Regions I through V in the peak concentrations from 1983 to 1988 were observed at:

	Percent
Stafford, CT.....	21
Acadia National Park, ME.....	30
Manchester, NH.....	74
Newark, NJ.....	30
Buffalo, NY.....	42
Rochester, NY.....	30
World Trade Center, NYC.....	51
Washington, DC.....	21
Johnstown, PA.....	44
Charleston, WV.....	25
Covington, KY.....	52
Greensboro, NC.....	30
Nashville, TN.....	37
Evanston, IL.....	34

The data summarized so far generally represent ozone measurement collected through mid-August, 1988. It should be understood that additional exceedances of the National Ambient Air Quality Standards (NAAQS) are likely to occur throughout the summer and that the 1988 peak concentrations may also increase. Even with this incomplete information, the following observations can be made:

Nationally, 116 out of 176 sites (65 percent) have more exceedances in 1988 than 1983, and 161 out of 199 sites (80 percent) have more exceedances in 1988 than 1987.

In the eastern half of the United States (EPA, Regions I, II, III, IV and V), 107 out of 147 sites (72 percent) have more exceedances in 1988 than 1983, and 153 out of 170 sites (90 percent) have more exceedances in 1988 than 1987.

In fact, in 1988, there were 1247 exceedances at these 170 eastern sites by August 15, compared to 632 for all of 1987 (an increase of 97 percent).

Examples of specific areas that observed major increases in the number of exceedances of the NAAQS between 1987 and 1988 are:

Area	Increase
Stafford, CT.....	From 2 in 1987 to 15 in 1988.
Acadia National Park, ME.....	From 1 in 1987 to 6 in 1988.
New Brunswick, NJ.....	From 6 in 1987 to 4 in 1988.
Philadelphia, PA.....	From 3 in 1987 to 17 in 1988.
Baltimore, MD.....	From 7 in 1987 to 17 in 1988.
Charleston, WV.....	From 0 in 1987 to 7 in 1988.
Atlanta, GA.....	From 7 in 1987 to 13 in 1988.
Covington, KY.....	From 2 in 1987 to 11 in 1988.
Raleigh, NC.....	From 2 in 1987 to 8 in 1988.
Evanston, IL.....	From 6 in 1987 to 16 in 1988.
Cleveland, OH.....	From 2 in 1987 to 11 in 1988.

DON CLAY.

SEPTEMBER 28, 1988

ATMOSPHERIC CONTAMINATION—XII

Mr. STAFFORD. Mr. President, this will be the 12th in a series of some 16 short talks on atmospheric contamination that the Senator from Vermont is delivering daily.

Earlier this month, the number of acres consumed by forest fires in Yellowstone National Park passed the 1 million mark—and was still climbing.

Three days later, the U.S. Department of Agriculture announced corn and wheat production were off by nearly half and soybeans by nearly a third.

About the same time, massive monsoon flooding covered more than half of Bangladesh, leaving tens of millions homeless and facing the prospect of epidemics of cholera, typhoid, and other diseases.

To a Senator who has sat in virtually empty hearing rooms for nearly two decades listening to witnesses predict some of the consequences of global warming, the news reports of these events had a chilling effect.

For many years, those who warned of global climate change were too often regarded as radicals warning about the end of the world. Even those who took the warnings seriously thought of global climate change as a threat generations—or even centuries—removed.

Perhaps one of those reactions is the truth.

But, it seems to this Senator that there are two possibilities:

First, 1988 is no fluke year of coincidences and natural variability, but it is actually the first year in which we have to realize the global warming trend has arrived.

Or, second, 1988 is just another hot year with just another one of the many droughts that periodically afflict the Nation.

In either case, in the judgment of this Senator, 1988 is a taste of things to come, and it isn't over yet. If 1988 is a product of global warming, then we have no time to waste.

If, on the other hand, events this year have been a series of coincidences, then it is our good fortune to have been granted a grace period—and there is no time to waste in that event, either.

For, if the scientists are correct, whenever the greenhouse event arrives, the good years will be like 1988 and the bad ones will be worse—much worse.

We have already experienced great reductions in soil moisture throughout the Great Plains of North America, Western Europe, Northern Canada, and Siberia. The fields are so parched it may take 3 or 4 years for conditions to return to normal—if they ever are to return to normal. And, last winter was warmer. Another sign.

In fact, everything that has happened in this decade has been consistent with the proposition that the greenhouse effect has arrived.

The decade of the 1980's has been the hottest on record. At the same time, the stratosphere has been cooling, just as models predict will happen when the Earth's surface warms up. There is also some evidence that deep ocean temperatures in the North Atlantic have increased—as they should when the Earth is warming.

There have been other indicators. More rain has fallen on areas near the Equator and less rain has fallen in the United States and in southern Europe. The number of days above 90 and 100 degrees Fahrenheit have increased. More extreme weather has happened—more thunderstorms and monsoons.

Each of these conditions is what would be expected with the arrival of the greenhouse effect.

It is, of course, possible that we are experiencing an uncanny series of coincidental happenings.

But, this Senator was a prosecutor for a good many years before I came to the Congress, and I tried many cases.

This is one case I would be happy to take before any jury in Vermont with confidence.

The case may not be proven to the satisfaction of the polluters or the skeptics, but it is clear to this Senator that if the greenhouse effect hasn't already arrived, it is not far away. Clearly there is enough evidence before us to require prudent men and women to begin to take the kind of action needed to reduce—and then to end—the kind of air pollution that threatens the very existence of life as we know it on this planet.

It is my intention tomorrow to discuss a circumstance created by air pollution in which there is no longer any credible doubt—the impact of acid rain and the soup of low-level air pollution.

SEPTEMBER 29, 1988

ATMOSPHERIC CONTAMINATION—XIII

Mr. STAFFORD. Mr. President, this is the 13th in a series of atmospheric contamination talks that the Senator from Vermont has been delivering during morning business.

As the temperatures rose in the summer of 1988 in the United States, so did the concentrations of low-level air pollution that we most often call smog.

Because so many air pollutants are invisible, or nearly so, we often fail to notice their presence. In much the same way, we overlook the damages caused by air pollution because those damages are often gradual and subtle.

But, evidence abounds of the air pollution toll that is being taken on the lakes, streams, and forests of both North America and Europe.

Forests are dying here and in Europe. Every major tree species in Europe and Eastern North America is suffering. In a few cases, the losses are visible even to the unskilled viewer.

At the peak of Mount Mitchell in North Carolina, for example, the ground is littered with the skeletons of thousands of acres of dead red spruce and balsam fir.

In other cases, the damage is less visible. For example, 80 million acres of yellow pine have begun to grow at only half their normal rate, while they are dying at twice the rate they were previously.

The Europeans call the circumstance forest death. It is worst in West Germany, where 55 percent of the trees are injured. One-third of the trees in Switzerland are suffering from forest death.

In the United States, foresters and scientists report extensive damage to all species of trees, with the damage bearing strong relationships to the levels of ozone.

Thus, here and abroad, where air pollution levels are high, trees are sick and dying. Where they are low, trees are not.

The same is true of lakes and streams.

Acid pouring into the waters has gradually destroyed their ability to absorb more pollution. The acid dissolves heavy metals such

as aluminum, lead and mercury from soils, washing them into lakes and streams where it poisons not only the fish, but also their food—insects, frogs, and microorganisms.

As striped bass have disappeared from lakes, streams, bays, and sounds in the Eastern United States, scientists have isolated two probable causes—water pollution and air pollution.

From the air comes a flood of toxic chemicals. During the spring spawning seasons, the air pollution also brings with it sudden jumps in acidity and heavy metals that kill the young fish.

The pollution is so potent that it has begun to alter even the soil itself, something most scientists only 5 years ago believed was not possible. Atop Mount Mitchell, the levels of lead in the soil are 150 times higher than they are in cities at sea level.

In Scandinavia, scientists have said that acid rain has turned even the deep soils—those 5 or 6 feet beneath the surface—acid. That is unheard of.

It is virtually impossible to come up with a dollar value on these losses, nor should the economic factor determine whether we should act. Still there have been rough estimates of the cost of this pollution.

For example, the National Acid Precipitation Assessment Program (NAPAP) has estimated ozone damage to agricultural crops at about \$1 billion annually in the United States. Other researchers have put the damage to buildings and materials at \$5 billion a year.

But setting an economic figure obscures what needs most to be understood—namely that we are talking about dilute solutions of bleaches, acids, and poisons. If a substance can damage the steel and concrete of structures, think what it can do to the human lung and to trees and crops.

Forests are dying. So are lakes, rivers, and bays. There are some who tell us even the oceans are suffering massive damage. The air in this Nation—and in other parts of the world—is so filled with chemicals and other contaminants that lungs ache and tears flow from eyes.

Yet, there are those who argue that we should wait until scientists have the proof necessary for absolute certainty that air pollution is the cause of each and every one of these afflictions.

But, surely common sense tells us—in overwhelming fashion—that the right thing to do, and the necessary thing to do, is to begin reducing air pollution as much as possible and as fast as possible.

Mr. President, I will be back tomorrow with another discussion of this same problem.

SEPTEMBER 30, 1988

ATMOSPHERIC CONTAMINATION—XIV

Mr. STAFFORD. Mr. President, this is the 14th in a series of short talks by the Senator from Vermont on atmospheric contamination. There are two still to go after today.

Mr. President, scientists are convinced that some very nasty times lie ahead for this old planet because of the way we have contaminated our atmosphere.

A workshop of the National Academy of Sciences concluded, 2 years ago, that the following series of happenings are either probable or very probable:

- The Earth's temperature will increase;
- The stratosphere will cool;
- The number of monsoons and hurricanes will multiply;
- Sea ice will melt;
- Oceans will expand and their levels will rise;
- The icecaps will shrink; and
- Dustbowls will overtake the world's breadbaskets.

The scientists also warned that we are pushing our climate and our environment into a realm that we literally have never experienced since the beginning of time.

There is literally nothing that can be done to avert these changes, for the forces that are creating them were set into motion by our actions in the decades of the 1940's, 1950's, 1960's, and 1970's.

So, it is no longer a question of whether there will be changes, but one of whether there will be sacrifices.

If we wish to minimize the damages that will surely accompany these changes, we must begin to plan for them now. We must take stock of the resources of our Nation—indeed, of the world—ranging from highways to wilderness preserves. And, we must begin to decide how we should act to preserve them.

Adjustments will have to be made in the way we farm to provide ourselves with food. We may not be able to count on the continued fertility of the great breadbasket of this Nation—or of the Great Plains of Europe and Asia.

Global warming, scientists tell us, could upset the natural equation that powers the great energy pump of the oceans which move massive quantities of food and water from one end of this planet to the other.

None of this is certain, of course. Even those scientists who are most concerned over the possibilities of massive disruptions of the climate on this planet are quick to say no one can predict this kind of future with any certainty.

But, that lack of certainty adds to their concern, as it should add to ours. For these scientists are agreed that our ignorance in these matters is so great that we are, in effect, conducting a dangerous global experiment without any idea of how things are going to turn out.

But, we probably can be certain of one thing—that we are in for some surprises.

The hole in the ozone layer over the Antarctic should teach us that. It was completely unexpected, even by those scientists who understood how the ozone layer was being destroyed by the releases of chlorofluorocarbons into the atmosphere.

So far, we have survived the ozone hole and the general depletion of the ozone layer that protects us from the deadly radiation of the Sun. But, with each passing year—even each passing month—we invite damages from what we already know has happened.

And, we may be inviting even more disastrous consequences from the next surprise.

We do not have to do that. We don't have to continue to gamble with the lives of our children and their children.

It is not too late to turn back from the course that we have been following. We can take a different road toward a better and more certain future.

Tomorrow, with your permission, I would like to discuss some of the ways we can do that.

OCTOBER 3, 1988

ATMOSPHERIC CONTAMINATION--XV

Mr. STAFFORD. Mr. President, the solutions to many of the problems created by atmospheric contamination are fairly obvious and not necessarily all that difficult. But, first we must overcome the fear of change, perhaps by acknowledging that change is by now inevitable.

It is no longer a question of whether there will be changes as a result of the contamination we have dumped into our atmosphere. The question is how extensive those changes will be and how quickly we can begin to moderate, or even reverse, them.

To ease the impact of the damages we have already set in motion, we will probably have to reverse a wide range of habits that have brought the globe to this condition. There are those who will say it is impossible to change these habits. There are those who will say it is not only impossible, but there is no need to do so. Others may agree it is possible to do so, but they will question the need to do so.

In the view of this Senator, it is not only possible for us to change our ways, but it is also essential that we do so—and soon. To continue business as usual is to gamble with the very future of this planet.

Also, it is important that we realize that the means of overcoming some of our problems are close at hand. Let us consider the depletion of the ozone layer and the role of chlorofluorocarbons (CFCs), or freons, as we know them, in that happening.

It is clear that the time has arrived for a worldwide ban on the production and use of CFCs. Or, if not a total ban, as close to it as possible, with exemptions for absolutely necessary functions where there are no substitutes.

Some CFC uses are so important that they are considered to be essential. Refrigeration is an example. But, in the United States, only 5 percent of the production of freons is devoted to refrigeration.

Most CFCs are used to blow foams—rigid foams such as those used in styrofoam cups and insulation, or soft foams such as those used in couch cushions. Substitutes are available for virtually all these uses, but they will not be developed and put into use in full

until the governments of the world mandate an end to the use of CFCs.

The Montreal Protocol, an international agreement to regulate and reduce the production of CFCs, is a good beginning, and it is a hopeful note. But, it falls far short of what is needed. Indeed, because of exemptions of certain chemicals and waivers granted to developing countries, the Montreal Protocol could result eventually in a 40-percent increase in CFC production over 1988 levels.

A worldwide ban on CFC production and use will require an expanded international agreement and worldwide cooperation. That does not mean that the United States should not take action on its own in an effort to exert international leadership in this matter.

We acted unilaterally to ban the use of aerosol cans in 1976 and, while that did not end the global use of CFCs for that purpose, it slowed the phenomenal growth of aerosols and bought more time for all of us. Similar unilateral action by our Nation today may inspire the rest of the world to accelerate its efforts to get CFCs out of our atmosphere.

In addition to banning the production of CFCs, the world must act to eliminate emissions of this chemical which threatens to destroy our planet's protection from the radiation of the Sun. CFCs should be disposed of only through incineration or recycling.

Releases into the atmosphere should be prohibited. Two-thirds of the CFCs used in the United States for automotive air conditioners are eventually lost into the air. The air conditioners and appliances should be designed so that the freons are contained and also can be easily drained and disposed of at the end of the life of the appliance.

To achieve this, the United States must persuade other nations of the world to cooperate, especially the less developed nations. We should provide them with help, including financial aid, so that they can enjoy the benefits that CFCs have brought to us.

In short, the world must complete the task that the United States began in 1976 when aerosol uses of CFCs of freon were banned here.

Unfortunately, eliminating carbon dioxide and other pollutants produced through the burning of fossil fuels cannot be so easily achieved as a CFC ban. But, the prospects are not entirely bleak, and tomorrow I propose to discuss that issue.

OCTOBER 4, 1988

ATMOSPHERIC CONTAMINATION—XVI

Mr. STAFFORD. Mr. President, this is the 16th in a series of short talks on atmospheric contamination that the Senator from Vermont has been delivering over the last 2 weeks. There will be one more summary of what I have said, before the week is out.

Mr. President, if we can agree that the solution to the depletion of our atmospheric ozone layer is obvious—the banning of chlorofluorocarbons; we know them as freon—then the solutions to acid

rain, ground level ozone, and global climate change are just as plain—the elimination of air pollution.

This goal cannot be accomplished in this century, of course, and probably not in the next. But, there is certainly no reason why we should not direct our efforts toward the smokeless use of coal, oil, and gas.

In the meantime, there are objectives that are less ambitious and more achievable in the short term.

About 75 percent of the carbon dioxide emitted in the United States comes from electric powerplants, motor vehicles, and homes. Those same sources also are responsible for most of the other air pollutants—sulfur dioxide, oxides of nitrogen, and carbon monoxide.

Vast amounts of each of these pollutants could be eliminated by simply increasing the efficiency of the polluting sources.

Powerplants in the United States operate at about 28 percent efficiency at present. New units in this country achieve 38 percent efficiency, while the Japanese claim 43 percent efficiency.

Simply replacing old units with new ones would reduce each air pollutant released from a powerplant by between 30 and 50 percent.

Even greater gains can be made in automobiles.

Cars in this country get about 24 miles on a gallon of gasoline. Volvo has a prototype family sedan that gets 60 miles to a gallon. Toyota has a car about the size of its Corolla model that gets 98 miles on a gallon of gasoline. And, these are real-world autos.

Efficiencies of equal magnitude are available in home furnaces, air conditioners, and hot water heaters. Models now commercially available are between 50 and 100 percent more efficient.

As matters stand now, this Nation wastes between 50 and 75 percent of the coal, oil, or gas we burn in our furnaces, automobiles, and homes. That waste adds to our air pollution problems, and is unnecessary today. For the future, we can do even better.

Scientists tell us that powerplant efficiencies of 75 percent are not out of reach. They describe technologies that convert coal into elemental carbon and hydrogen, which would allow one to be buried and the other to be burned.

For those who argue the cost of these new efficiencies is too great, the answer is that our present inefficiencies are costing us money by raising the prices of our products. And, of course, we are poisoning ourselves, our environment and our future by dumping unburned fuel into the atmosphere.

We are keeping ourselves hostage to energy-rich nations by wasting fuel and we are placing our products at a disadvantage in world trade because they bear the added cost of wasted fuel.

Earlier this year I introduced S. 2666, the global environment bill. It proposes a comprehensive series of solutions to the contamination of our atmosphere. I ask that a summary of that bill be printed in the Record at the conclusion of my remarks.

Mr. President, I would, of course, be delighted if that bill were enacted into law by some miracle before I left this body. But even that would not solve the air pollution problems we have inflicted upon our planet. Indeed, we need more than all the laws that could be passed by all the legislative bodies of the world.

We need a reappraisal of our responsibility to this planet and to all of its inhabitants, present and future. That reappraisal must be undertaken by all of our institutions—including government, industry, business, and science. There is no lack of solutions to the problem—there is only a lack of resolve to do the right thing.

Our world is hotter than ever before.

Our ozone shield is thinner than ever before.

Our atmosphere is increasingly saturated with chemicals that threaten our very existence.

And none of this is necessary.

While the prospect of necessary change may be daunting, surely it also presents us with an opportunity to correct past errors and to free our planet from technologies that have outlived their usefulness.

Surely we can do no less than attempt our own rescue. If we succeed, our legacy to our children—and to their children—will be not just a better life, but life itself.

GLOBAL ENVIRONMENT BILL OUTLINE

The general approach of the bill will be to have five titles, as follows:

Title I: Regulation of Global Change Pollutants.

Title II: Climate Change Adjustment and Mitigation.

Title III: International Cooperation.

Title IV: Elevation of EPA to a Cabinet Level Agency.

Title V: Development of Non-Polluting Power.

Reductions: Initial rough calculations are that the bill would reduce CO₂ emissions in the United States by about 35 percent in the year 2010 assuming, conservatively, no growth in the size of the vehicle fleet. CFCs would be completely eliminated, except for essential medical uses, by 2000. In the absence of an adequate computer model to measure the effects of such changes, a best guess of the bill's effect on warming trends is that it would eliminate one to two degrees of the projected eight degree F global temperature increase.

TITLE I—REGULATION OF GLOBAL CHANGE POLLUTANTS

1. Coverage:

- a. Chlorofluorocarbons (CFCs)
- b. Carbon dioxide (CO₂)
- c. Ozone (O₃) (via oxides of nitrogen (NO_x) and hydrocarbons (HC))
- d. Methane (CH₄)

Regulatory programs: CFCs

Goal: complete elimination of halogenated CFC use and sale by 1999.

1. Bans on production and sale:

A. Fully halogenated CFCs: six years from the date of enactment, the production of fully halogenated CFCs is prohibited. Uses, except for essential medical uses, are banned five years later.

B. Partially halogenated CFCs: ten years from the date of enactment, the production of partially halogenated CFCs is prohibited. Uses, except for essential medical uses, are banned five years later.

C. Exceptions:

- i. essential medical uses are excluded from the bans on production and sale.

2. Regulations on production and disposal:

A. Effective 24 months after the date of enactment, the use of CFCs except in a totally enclosed system is prohibited. Totally enclosed systems must—

- i. Preclude the release of any more than 5 percent of the original charge during the life time of the equipment;
- ii. Be equipped with servicing apertures to allow removal and storage of CFCs during repair or maintenance of the equipment.

B. Effective 12 months from the date of enactment, the storage, treatment and disposal of CFCs, or appliances or goods containing CFCs, must be regulated under subtitle C of RCRA, which shall require all waste CFCs to be incinerated to 99.999 percent destruction of disposed CFCs (or a chemical treatment equivalent thereof). (Recycling is not disposal under RCRA)

Regulatory program: CO₂

Goal: The achievement of a 50 percent reduction in emissions of CO₂ by the year 2000.

1. Regulation of new sources:

A. Vehicles: effective with model year 1990, vehicles are required to achieve CO₂ emissions reductions below 1985 as follows:

	<i>Present</i>
1990.....	10
1995.....	25
2000.....	50
2010.....	75

B. Stationary sources:

i. Powerplants: fossil-fuel fired electricity generating plants are required to achieve CO₂ emission limits reflecting the following efficiencies:

	<i>Present</i>
1990.....	35
2000.....	50
2010.....	75

ii. Residential Units: effective five years from the date of enactment, all new homes are required to be equipped with furnaces and hot water heaters emitting CO₂ in an amount not exceeding the equivalent of the best efficiencies currently available commercially and air conditioners with an energy efficiency rating of not less than 15.0.

Regulatory programs: methane

1. Source identification: require EPA to inventory and report on all sources of CO₂ emissions by January 1, 1991.

2. Interim requirements:

A. Wells and refineries: effective January 1, 1994, prohibit the mass releases or flaring of methane.

B. Landfills:

New: require new landfills opened after January 1, 1993 to be designed, constructed and operated to minimize emissions of methane and other air pollutants;

Existing: require all existing landfills to be retrofitted by January 1, 1993 to minimize emissions of methane and other air pollutants.

TITLE II—GLOBAL CHANGE ADJUSTMENT AND MITIGATION

1. NEPA amendment: amend NEPA to (a) require preparation of environmental impact statements on the effects of proposed action on the global environment; and (b) minimize the impacts of the proposed action on the environment.

2. Federal public works survey: require the Federal government to undertake a comprehensive survey of all federally-owned lands (national parks, wilderness areas, etc.) and public works (highways, buildings, military bases, etc.) to determine their vulnerability to global changes. Also, require the development of site-specific mitigation plans.

3. Private investment: require a Presidential report recommending actions and policies to preclude public or private investment in susceptible areas.

4. Corps of Engineers: expand the authority of the Corps of Engineers to include climate change mitigation measures, including—

a. Identification and mapping of areas likely to be adversely affected by increases in sea level or other environmental changes; and

b. Provision of water supplies for ground-water recharge.

2. Regulation of existing sources:

A. Powerplants: effective in 1995, establish a mandatory retirement age of 30.

B. Industrial/commercial: effective in 1995, establish a mandatory retirement age of 35.

C. Residential: effective in 1995, require that all furnances and CAC replacements meet the standards described above.

Regulatory programs: ozone

1. Oxides of nitrogen:

A. Vehicular sources: a tailpipe NO_x limit of .4 (down from the current law's requirement of 1.0) grams per mile is established. Nationwide I&M and a 10 year/100,000 mile warranty are required.

B. Stationary sources:

i. New: effective in 1991, require a 90 percent reduction in emissions of oxides of nitrogen from each newly constructed source.

ii. Existing: effective in 1995, require each major utility source to reduce NO_x emissions by 90 percent upon reaching its 30th anniversary and each major industrial/commercial source to reduce NO_x emissions by 90 percent upon reaching its 35th anniversary.

2. Hydrocarbons

A. Vehicular sources: a tailpipe HC limit of .25 (down from the current law's requirement of .41) grams per mile is established. On-board vapor recovery is also required.

B. Stationary sources:

i. New: 50-state BACT by 1993.

ii. Existing:

Require each major source to install BACT on its 30th anniversary of operation or 1995, whichever is later.

Require new regulations for the control of specified categories of existing sources to be promulgated.

TITLE III—INTERNATIONAL COOPERATION

1. Governmental cooperation: require the President to petition the United Nations to establish a temporary new agency, to be headed by the director of the United Nations Environmental Program, to—

a. Coordinate international efforts to minimize and mitigate the effects of unavoidable environmental alternations;

b. Provide financial, technical and other assistance to developing nations to enable improvements in the standard of living while avoiding aggravation of global, continental and subcontinental scale environmental damages.

2. Deforestation: require the President to petition the United Nations to establish a temporary program of forestation to—

a. Halt deforestation and desertification; and,

b. Reforest areas already cleared

TITLE IV—ELEVATION OF EPA TO CABINET LEVEL

Without increasing the authorities of the Environmental Protection Agency, confer on its cabinet status.

TITLE V—NON-POLLUTING ENERGY SOURCES

Nuclear: establish a temporary National Commission on Inherently Safe Nuclear Energy to report to the Congress by January 1, 1994 on—

a. The reasons for public fears and apprehensions regarding the safety of nuclear energy and ways to allay such fears by responding to them substantively (e.g. building in safety margins which engineers might consider unnecessary, etc.).

b. The prospects for developing inherently safe nuclear technologies.

c. The reasons for different safety records between domestic companies and between the United States and other nations, and ways to assure that the best records become the industry standard.

General: establish as a national goal of the United States to generate 100 percent of the nation's power from non-polluting energy sources by the year 2050.

OCTOBER 5, 1988

ATMOSPHERIC CONTAMINATION—XVII

Mr. STAFFORD. Mr. President, the bad news is that our planet's air is dirty and it is going to get dirtier unless we take strong measures to reverse that trend. The good news is that those strong measures are readily available to us and we can clean up our act if we really want to.

That is the essence of the daily remarks I have delivered during each of the last 16 days with the forbearance of the Senate. I have discussed in some detail the threat to humanity posed by atmospheric contamination and some practical ways of responding to that threat.

In this concluding report on atmospheric contamination, I would like to review and summarize the problems and appropriate solutions.

AIR SUSTAINS OUR LIVES

Air is not naturally occurring on our planet. The atmosphere is produced by living things—animals produce the carbon dioxide and plants produce the oxygen.

Once the atmosphere has been created, it traps heat and, thus, enables life to continue and to change. The atmosphere also provides living things with protection from the radiation of the Sun. That radiation is strong enough to kill us, except for the screening provided by the atmosphere.

The air is also the source of nutrition. Just as we eat food to stay alive, so must we breathe air to survive.

That's why we must protect the food we eat and the air we breathe from contamination.

But, our air has been poisoned by pollution. That pollution has reached the point where humans, animals, fish, and plants have become ill—and even have died.

Pollution has also upset the atmospheric mix that allows just the right amount of life-sustaining heat from the Sun to enter and to leave our environment. As a result, the Earth is getting warmer—and that global warming threatens to create major changes in life on this planet.

Our carelessness in releasing manmade chemicals into the atmosphere has caused a thinning of the ozone layer—the shield that protects us from the Sun's deadly radiation. At the Antarctic, that thinning has become a hole each winter.

And, of course, we are all familiar with the various forms of air pollution closer to the ground—the pollution from tailpipes and smokestacks that irritates our eyes and our lungs and that threatens our health most directly.

THE NATURE OF THE THREAT

The technological development and economic activity that have brought us an enhanced standard of living have also changed the nature of the pollutants that now threaten our lives.

Our accelerating uses of fossil fuels and of manmade chemicals have placed all inhabitants of Earth at risk.

Chlorofluorocarbons—Freons, as they are known commercially—are the known cause of depletion of the ozone layer.

Carbon dioxide plays a key role in global warming.

Sulphur dioxide threatens human health and also is a major cause of acid rain.

Oxides of nitrogen and ground-level ozone threaten both human health and our environment.

Other pollutants—such as methane and carbon monoxide—play catalytic roles with other air pollutants.

Some of the consequences of these pollutants include global climate change, ground-level smog that threatens humans and trees, acid rain that kills trees, and the combination of all these that combine to make a deadly atmospheric soup.

CHLOROFLUOROCARBONS AND THE OZONE LAYER

Production of chlorofluorocarbons (CFCs) was minimal until 1931, but by 1984 nearly 1.5 billion pounds of CFC 11 and CFC 12—just two members of the Freon family—were being produced.

Because this family of chemicals has a lifetime of between 100 and 150 years, each and every molecule of CFCs ever produced by man is still in existence today and will be around for another century or so—destroying ozone molecules day after day.

When the CFCs are released into the atmosphere—as they are day after day—they destroy ozone molecules in the stratosphere. It is the ozone layer that protects this planet from the deadly radiation of the Sun.

That layer is being weakened everywhere by CFCs. In addition, over the Antarctic a hole as big as North America occurs in the ozone layer every winter.

The message is surely clear—the release of CFCs into the air is a threat to life on Earth. We must stop using CFCs as a blowing agent for cushions and building material; as refrigerants, and as a solvent in the computer chip industry.

Even the U.S. Environmental Protection Agency has reached that conclusion, although somewhat belatedly.

FOSSIL FUEL COMBUSTION

This may be a good place to remind ourselves that we Americans each year dump an average of 37,000 pounds of air pollution into the atmosphere for each man, woman, and child in our country.

Our use of fossil fuels to power our development in this world has resulted in sixfold increases in annual sulphur dioxide emissions since 1900. Nitrogen oxide emissions have increased tenfold in the same period. These gases, along with hydrocarbons, are the major sources of both urban air pollution and acid rain.

There is more. A large tank of gasoline produces about 400 pounds of carbon dioxide when that fuel is consumed. The average electric powerplant sends 2 pounds of coal up its smokestack for every pound it converts into electricity.

Most of the pollutants we pump into the atmosphere do not exist in nature and, when some do, they do so in vastly smaller quanti-

ties than man produces. So, it is easy for us to overlook the enormous aggregate total—and the extreme potency—of many of these pollutants.

For instance, the EPA has established 120 parts per billion of ozone as a level that is safe. In an earlier discussion, that level was inadvertently set at 12 parts per billion. But, at 120 parts per billion, ozone begins to change cell walls on the human lung within seconds. And, the level of ozone and other ingredients of the soup of pollution we breathe is thicker and more unhealthy than ever before.

Clearly, the time has come for us to uncouple the direct relationship of advances in our standard of living and increases in air pollution.

THE GREENHOUSE EFFECT

The impact of the Sun's light on the soil and water of Earth is enough to generate heat. Much of this heat is reflected back toward space as infrared radiation, but some of it is retained, including the heat that is trapped by the gases that form our atmosphere.

This is called the greenhouse effect, because it works the same way as glass panels in a hothouse trap solar heat before it has a chance to escape.

A variety of circumstances combine to determine the climate and the heat of this planet, but scientists today are convinced global temperature is at or near its high point in a million years. And, that temperature may be going up—all because of air pollution.

The pollutants we are releasing into the air are trapping more and more heat in the Earth's atmosphere. These pollutants are carbon dioxide, CFCs, nitrous oxide, methane, and ground-level ozone—or smog.

We are surrounded by the signs. The years 1980, 1981, 1983, and 1987 are the hottest 4 years in record history—and 1988 promises to be hotter still.

Forest fires in our West are the worst in history. Glaciers have retreated in Alaska. Warm water is believed to be the cause of coral kill in the Caribbean. Red spruce are growing faster without explanation.

Carbon dioxide is the air pollutant that traps most of the heat and concentration of carbon dioxide have been rising steadily.

The CFC family is another major greenhouse gas, and accounts for about 20 percent of the global warming.

Another major pollutant with greenhouse impact is ground-level ozone, which we most often call smog. It is formed when hydrocarbons, like unburned gasoline, and oxides of nitrogen react in the presence of sunlight. With the high temperatures of this decade have come the highest smog levels in the country since the 1970's.

The consequences of continued global warming should be cause for global alarm. Unless action is taken to halt the rising tide of these pollutants, scientists warn that this planet's temperature will continue to rise to the point where it will be the same as if the Earth had moved 1 million miles closer to the Sun.

These same scientists tell us that could result in the following circumstances:

The Earth's temperature will increase; the stratosphere will cool; the number of monsoons and hurricanes will multiply; sea ice will melt; oceans will expand and their levels will rise; the ice cap will shrink; dustbowl will overtake the world's breadbaskets, and our lives will be very, very different.

ACID RAIN AND SMOG

There is no longer any question that atmospheric contamination has killed forests in North America from North Carolina to Vermont, as well as in Europe.

We can argue whether the killer pollution has been acid rain or ozone, or a combination of the two with other pollutants. But, it is clear that what we have called acid deposition is causing massive damage throughout North America and Europe.

And, that acid rain caused by oxides of nitrogen and sulphur dioxide damages more than forests. Acidic rain damages lakes and streams and the plant and fish life of those waters.

The soup of air pollutants that is becoming all too common in this country also damages the health of not only the very young and the very old and those with respiratory diseases, but also of those who are healthy and strong.

More than 100 million Americans are breathing air that does not meet Federal health standards. And, 35 million of those Americans live in dirty air regions where the air quality has actually gotten less healthy since 1981.

It is not just those who live in our big cities who are at risk. Scientists tell us that ozone levels in rural areas of Europe and even in the middle of the Pacific Ocean have doubled and tripled in the last century.

TAILPIPES AND SMOKESTACKS

Motor vehicles generate more air pollution than any other single human activity. Electric utilities hold down second place.

Cars and trucks are the major sources of carbon monoxide, oxides of nitrogen and hydrocarbons. They are a significant source of carbon dioxide and, particularly in this country, of CFCs. All of these pollutants cause or contribute to the formation of smog. And, some of them are enemies of the stratospheric ozone layer.

There were less than 50 million cars on this planet in 1950, and 85 percent of them were in North America. The auto population is now about 350 million, with 125 million of those outside North America. It is expected there will be more than 500 million motor vehicles on Earth by the year 2000.

Behind motor vehicles in the production of air pollution come electric powerplants. One third of all oxides of nitrogen released into the air of this Nation comes from powerplants. The figure is about the same for carbon dioxide emissions.

More than two-thirds of the coal, oil, and gasoline used to fuel our powerplants and motor vehicles is wasted because of the inefficiency of our technology—and that means more pollution than necessary.

TOWARD A BETTER, HEALTHIER FUTURE

An examination of the causes of atmospheric contamination provides us with the solutions to the problem—and also suggests that those solutions are not too difficult to achieve. But, first, we will have to overcome the fear of change.

That should not be too hard to do, since we must know by now that change is not only necessary, but it is inevitable. Clearly, we will have to change if we are to survive.

To continue business as usual is to gamble with the very future of our planet.

Let us first consider the depletion of the ozone layer and the role of CFCs in that happening.

It is clear that the time has arrived for a worldwide ban on the production and use of CFCs, or freons as they are known to most people. If we can not accomplish a total ban, we had better get as close to it as possible, with exemptions for only necessary functions where there are no substitutes.

CFCs are considered to be essential in refrigeration, but in the United States only 5 percent of Freon production is devoted to refrigeration.

Most CFCs are used to blow foams—rigid foams such as those used in styrofoam cups and insulation, or soft foams such as those used in couch cushions. Substitutes are available for virtually all these uses, but they will not be developed and put on the market until CFCs are banned.

Much the same condition exists for the use of CFCs in air conditioners and as cleaning agents in the electronics industry. In addition, the world must act to eliminate the releases of CFCs into the atmosphere. CFCs should be disposed of only through incineration or recycling.

But those are all attainable goals and will protect life on this planet from increased radiation from the Sun that results from depletion of our stratospheric ozone layer than shields us from the Sun's radiation.

If we must ban CFCs to protect our ozone shield, then it is clear that we must seek to immediately reduce—and eventually eliminate—air pollution if we are to solve our acid rain problem.

About 75 percent of the carbon dioxide emitted in the United States comes from electric powerplants, motor vehicles, and homes burning fossil fuels. These same sources are also responsible for most of the other air pollutants—sulphur dioxide, oxides of nitrogen, and carbon monoxide.

Vast amounts of each of these pollutants could be eliminated by simply increasing the efficiency of the polluting sources. And, the technology is at hand for achieving that goal.

New powerplants in this country achieve 38 percent efficiency. Old powerplants operate at 28 percent efficiency. The Japanese claim they achieve 43 percent efficiency with their new powerplants. Thus, by simply replacing old units with the best available current technology, air pollution could be reduced by as much as 50 percent from these sources.

Greater gains are available from automobiles. Volvo has a sedan that gets 60 miles on a gallon of gasoline. Toyota has a car that gets close to 100 miles on a gallon of gasoline.

Similar efficiencies are available in home furnaces, air conditioners, and hot water heaters.

As matters stand at present, we waste between 50 and 75 percent of the fossil fuel we burn in this country's automobiles, furnaces, and homes. That waste adds to our air pollution and it is not necessary. It damages our health and our environment and it costs us money and resources.

Science tells us that even greater efficiencies are available in the future, efficiencies that can save us money and end our deadly habit of poisoning ourselves, our environment, and our future.

So, there is no lack of solutions, only a lack of resolve.

However, as the danger we face from atmospheric contamination grows clearer each day—as it did this summer, for instance—I am confident we will take the steps that are already available to us to rescue ourselves from the hazards of our own creation.

We can do no less if we are to meet our responsibility to future generations and to the survival of our planet.

